which a natural suspected hybrid is known, a duplicate of which Miss Slosson produced culturally. Most of his experiments at crossing were made with species in unrelated genera, *e. g., Pteris* and *Athyrium,* two genera belonging in entirely different tribes. Also, he cites as the best evidence previous to his paper the work of C. Voegler, who was unable to obtain fusion between the sperms and eggs of several pairs of unrelated fern genera, some of them genera from very distinct families, *e. g., Ceratopteris* and *Dicksonia, Dicksonia* and *Nephrolepis,* et al.

The case, then, for fern hybrids, stands just where it did and is based on facts which require reasonable explanation. The evidence favoring hybrids has been fully presented, and does not need recapitulation. It is quite true that experimental proof of the kind attempted by Hoyt and Voegler is lacking. No one has ever observed the development of a suspected hybrid from before the period of fusion of the gametes. But such evidence is not usually required in cases of reputed hybridity. The arguments advanced by Mr. Hoyt against fern hybridity apply with practically equal force to most cases of accepted hybridity among flowering plants and in animals.

In conclusion, then, these reputed fern hybrids possess in all respects the characters generally recognized as characteristic of hybrids. The existence of these plants demands some explanation, and their identification as hybrids furnishes the simplest and most reasonable one yet offered.

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THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE AND AFFILIATED SOCIETIES
SECTION B—PHYSICS

THE annual meeting of the American Association for the Advancement of Science, Section B, Physics, was held in the physical laboratory of the University of Minnesota, at Minneapolis, December 28–30, 1910. It was a joint meeting with the American Physical Society. Three forenoon and three afternoon sessions were held. Of these, two were "general interest" sessions, in charge of the officers of Section B and four were occupied with the reading of research papers, in charge of the American Physical Society.

The presiding officers were Dr. E. B. Rosa, vice-president of Section B, and Professor Henry Crew, president of the Physical Society. At a short business session of Section B Professor O. M. Stewart was elected a member of the council, Professors A. Zeleny and K. E. Guthe members of the sectional committee and Professor G. W. Stewart a member of the general committee.

All sessions were held in the lecture room of the Physics Building of the University of Minnesota. The dinner on Thursday evening with the mathematicians and engineers at the Commercial Club was a very pleasant and enjoyable occasion.

The officers for the next annual meeting, to be held in Washington during the convocation week of 1911–12, are as follows:

Vice-president and Chairman of Section B—Professor R. A. Millikan, University of Chicago.

Retiring Vice-president—Dr. Edward B. Rosa, Bureau of Standards, Washington.

Secretary—Professor Alfred D. Cole, Ohio State University, Columbus.

Members of the Sectional Committee—E. B. Rosa, R. A. Millikan, A. D. Cole, K. E. Guthe, A. P. Carman, G. F. Hull, E. L. Nichols, A. Zeleny.

The address of the retiring chairman of Section B, Dr. L. A. Bauer, was given Thursday afternoon on the subject "The Broader Aspects of Research in Terrestrial Magnetism." This was a joint session with Section D, whose vice-presidential address was delivered at the same time by Professor J. F. Hayford, on "The Relation of Isostasy to Geodesy, Geology and Geophysics." The former of these addresses is presented in full in SCIENCE, January 13, 1911, and the other will be published soon.

At the other general interest session the following program was presented:

"Recent Advances in Phosphorescence and Fluorescence," Professor Edw. L. Nichols, Cornell University.

"The Isolation of Ions," Professor R. A. Millikan, University of Chicago.

"The International Electric Units" (report on changes to go into effect January, 1911), Dr. E. B. Rosa, Bureau of Standards, Washington.

"Osborne-Reynolds's Theory of Gravitation," John Mackenzie, M.E., Minneapolis.

Abstracts of three of these papers follow. (That of Professor E. L. Nichols will probably appear in the next issue.)

The Isolation of Ions: Professor R. A. MILLIKAN.

This paper presented the methods used and the results obtained thus far in the work on the properties of isolated ions. It contained a more complete discussion of the material which was summarized in the issue of SCIENCE of September 30, 1910, and in addition new results obtained in collaboration with Mr. Harvey Fletcher—(1) on the question of valency in gaseous ionization, (2) on the causes of the irregularities obtained by Ehrenhaft in Vienna in his recent work on *e*. The new work only is here briefly summarized. The tabulated experimental data upon which the conclusions rest are soon to be published elsewhere.

1. In the work previously published it was conclusively shown that the great majority of atmospheric ions carry the elementary electrical charge, but there seemed to be some evidence that ions of larger valency were occasionally formed. This evidence was found in the fact that an oil drop suspended in a strong electrical field would occasionally catch, under the influence of radium, two or three elementary charges at once *when the field was on.*

The only preceding evidence in favor of the existence of valency in gaseous ionization is contained in the experiments of Townsend[1] and of Frank and Westphal,[2] which seemed to their authors to establish the production of some doubly valent positive ions by X-rays, but not by other ionizing agents.

We accordingly suspended minute drops of oil in an electrical field and produced a thin sheet of X-ray ionization in the air just beneath the drop, but no rays were allowed to fall upon the drop itself. The drops experimented upon were positively charged and the direction of the field was such that only positively charged ions could be thrown upon them. *Although we used rays of varying degrees of hardness we found in 125 catches not one which represented the advent of a multiple charge upon the drop.* These experiments present therefore direct, definite, unmistakable proof that the act of ionization of air by primary X-rays, even when these rays are of extreme hardness, consists in the separation of one single elementary charge from a neutral molecule.

[1] *Proc. Roy. Soc.*, 80, p. 207, 1908; 81, p. 464, 1908, and 82, p. 18, 1909.

[2] *Verh. d. D. Phys. Ges.*, März, 1909, and Juli, 1909.

When β rays of radium were used as the ionizing agent it was occasionally found possible, as in the work previously reported, to catch at once upon a single drop two or three elementary charges, *provided the drops were of sufficient size; but when the drops were very small we caught only singles.* This shows we think that all of the double and treble catches heretofore observed were due to the simultaneous catching by a large oil drop of two or three ions coming from two or three different molecules rather than to the separation from a single molecule of two or three elementary charges. In other words the capture of a number of elementary charges at once upon large drops furnishes no argument for the production of ions carrying two or more elementary charges, unless similar results can be obtained with small drops, and this we never found to be the case. Since it was only in the case of X-rays that evidence for valency in gaseous ionization had been previously found *the present experiments seem to remove all ground for supposing that the act of ionization of a gas ever consists in the expulsion from a single molecule of more than one elementary electrical charge.*

2. When we used oil drops of smaller radius than about .00004 cm. we found that the remarkable consistency in the successive values of the times of fall under gravity shown in the work previously published (see SCIENCE, September 30) was replaced by greater and greater irregularities as the drops became smaller and as the distance between the cross hairs was diminished. The explanation lies in the fact that the displacements due to Brownian movements become in such cases comparable with the displacements produced by gravity during the time of observation. The correctness of this explanation is proved conclusively by tables prepared by Mr. Fletcher which show that the observed distribution of "times of fall" between fixed cross hairs .07 mm. apart agrees perfectly with the distribution of these times *computed* from the theory of probability as applied to Brownian movements. These considerations offer a complete explanation of the irregularities observed by Ehrenhaft, since he used a cross hair distance of about the value mentioned above and worked with particles the radii of which were on the average about one fifth of those of our smallest drops previously reported upon.

Ehrenhaft's failure to observe Brownian movements with platinum and gold particles while he

saw them clearly with "phosphornebel" is presumably due to the fact that, the kinetic energy of agitation of all particles being the same, the *velocity* of agitation of a platinum particle would be but about one fifth of that of a particle of like size in a cloud of phosphorus despite the fact that, as shown by Einstein's formula,

$$\overline{X}^2 = \frac{RT}{N^3 \pi a \mu} \tau,$$

the displacement along X in a time τ would be the same for the two particles. In other words, while the "drift" of a Brownian particle is inversely proportional to its radius and *independent of its mass*, the "instantaneous speed" of a particle of given radius is inversely proportional to the square root of its mass. There is then nothing whatever in Ehrenhaft's work to raise a suspicion as to the correctness of any of the conclusions which have been drawn from our observations.

The International Electrical Units: Dr. E. B. ROSA.

The international electrical units current in all countries throughout the world are based upon the definitions and numerical values adopted at Chicago in the International Electrical Congress of 1893, except that the numerical value of the standard cell, adopted by Germany and some other countries, was slightly different from that recommended by the congress, which latter value was legally adopted in America, England, France and some other countries. In order to secure international uniformity so that the ampere and the volt, as well as the ohm, should be the same in every country, an international research was carried on at the Bureau of Standards, during April and May of last year, in which the standards of the national laboratories of England, France and America were compared and the silver voltameter was investigated. As a result of this cooperative effort, the International Committee on Electrical Units and Standards has agreed to recommend to all the governments represented in that committee the adoption of a new value for the Weston Normal cell, which has the effect of changing the numerical value of the international volt and also of the international ampere. The new value of the Weston Normal cell, at 20° C., is 1.0183. The previous value in America was 1.0191, whereas in Germany it was 1.0186, and in England for the last two years it has been 1.0184 although previously it was higher than the value in this country. There will be, as soon as the new value has been generally adopted, international uniformity with respect to the value of the units of resistance, current, voltage and power. It will, of course, require some time before the new values come into general use, although it is expected that they will be officially adopted in all countries at an early date. The Bureau of Standards adopted the new value January 1, 1911, and certificates issued by the bureau after that date will be in terms of the new units. The difference is, of course, inappreciable in ordinary engineering operations, but is very important in precise measurements, and is appreciable even in photometric measurements of electric lamps, in which the voltage or current, or both, are given.

Osborne-Reynolds's Theory of Gravitation: Mr. JOHN MACKENZIE, M.E., Minneapolis.

In contrast with the ordinary view that space is filled with an ether of very low density, Reynolds's view is that space is filled with a granular medium of very high density. The grains are small, hard spheres. The density of this medium is 10,000 times that of water. The grains are usually arranged in "normal piling." Where matter exists this arrangement is disturbed and a less number of grains occupies the same space. This is "abnormal piling." Matter is then negative mass. An atom of matter consists of a nucleus of grains in normal piling surrounded by a shell of grains in "abnormal piling."

The grains have motion relatively to one another, but the mean path of the motion is only a very small fraction of their diameter. This motion renders the medium elastic. An experiment with billiard balls was used to illustrate mass motion in space, defined as a "coming in of grains in front and leaving of grains in the rear."

To illustrate the difference between normal and abnormal piling of grains a rubber balloon filled with sand and water was subjected to pressure by placing a 75-pound weight upon it. The sinking of the liquid in an attached manometer tube showed that the addition of the weight *increased* the total volume of the intergranular spaces occupied by the water.

Reynolds holds that there is no attraction residing in masses of matter, but where abnormal piling (bodies of matter) exist, the pressure of the surrounding medium tends to restore normal piling and incidentally masses are driven together. This is gravitation.

The theory is also applied to the explanation of cohesion, electricity, magnetism, light and other physical phenomena.

At the joint sessions for the reading of research papers the following list was presented:

"The Ratio of the Two Heat Capacities of Carbon Dioxide as a Function of the Pressure and the Temperature," A. G. Worthing, University of Michigan.

"On the Adiabatic Expansion and Porous Plug Effect in Water between 0° and 40°," John R. Roebuck, University of Wisconsin.

"The Acoustic Shadow of a Sphere; the Theory and Certain Practical Applications," G. W. Stewart, State University of Iowa.

"On the Function of Rest in Restoring a Platinum-iridium Wire to its Annealed Condition," L. P. Sieg, State University of Iowa.

"The Nature of the Recovery of Light-positive and Light-negative Selenium," F. C. Brown, State University of Iowa.

"On the Fluorescence Spectra of the Uranyl Salts and the Structure of Luminescence Spectra in General," Edward L. Nichols and Ernest Merritt, Cornell University.

"The Effect of Red and Infra-red on the Decay of Phosphorescence in Zinc Sulphide," Herbert E. Ives and M. Luckiesh, National Electric Light Association, Cleveland, O.

"Ocean Currents and Barometric Highs," W. J. Humphreys, Mount Weather Observatory, Bluemont, Va.

"Ocean Currents and Barometric Lows," W. J. Humphreys, Mount Weather Observatory, Bluemont, Va.

"The Light-emission of Tungsten, Tantalum and Carbon as a Function of their True Temperature," C. E. Mendenhall and W. E. Forsythe, University of Wisconsin.

"The Pentane Lamp as a Primary Light Standard," E. B. Rosa and E. C. Crittenden, Bureau of Standards.

"Experimental Indications of the Nature of Magnetism," S. R. Williams, Oberlin College.

"The Effect of Magnetization on the Optical Constants of the Magnetic Metals," L. R. Ingersoll, University of Wisconsin.

"The Second Postulate of Relativity," O. M. Stewart, University of Missouri.

"A Preliminary Report of Experiments on the Effect of Changes in the Pressure of Gases upon the Mobility of Positive and Negative Ions Produced by the Discharge of Electricity from a Fine Point," E. J. Moore, Oberlin College.

"The Transmission of Excited Radioactivity," Wellish, Yale University.

"The Coefficient of Recombination of Ions in Carbon-dioxid and Hydrogen," Harry A. Erikson, University of Minnesota.

"A Method of Measuring the Fluctuations in a Rapidly Varying Resistance," F. C. Brown and W. H. Clark, State University of Iowa.

"The Causes of Zero Displacement and Deflection Hysteresis in Moving-coil Galvanometers," Anthony Zeleny, University of Minnesota.

"The Effect of Wave Form upon Incandescent Lamps," M. G. Lloyd, Chicago, Ill.

"Diffraction and Secondary Radiation with Short Electric Waves," A. D. Cole, Ohio State University.

"Notes on the Discharge of Electricity through Gases," G. S. Fulcher, University of Wisconsin.

"The Free-expansion and Joule-Kelvin Effects in Air and in Carbon Dioxide," A. G. Worthing, University of Michigan.

"On the Temperature Coefficients of the Free and the Absorbed Charges in Electric Condensers," Anthony Zeleny, University of Minnesota.

"Terminal Velocity of Fall of Small Spheres in Air at Reduced Pressures," L. W. McKeehan, University of Minnesota.

"The Electrical Discharge between a Pointed Conductor and a Hemispherical Surface in Gases at Different Pressures," Franz A. Aust, University of Minnesota.

"The Effect of Distance upon the Electrical Discharge between a Point and a Plane," O. Hovda, University of Minnesota.

"A Lecture Electroscope for Radioactivity."

"A Variable High Resistance of India Ink on Paper," Franz A. Aust, University of Minnesota.

"The Electrical Discharge from Liquid Points," John Zeleny, University of Minnesota.

"A Microscope Plate Micrometer," John Zeleny and L. W. McKeehan, University of Minnesota.

"A Kinetic Theory of Gravitation," Chas. F. Brush, Cleveland.

"On a Variation in the Intensity of the Penetrating Radiation at the Earth's Surface observed during the Passage of Halley's Comet," Arthur Thomson, University of Toronto.

"On the Resolution of the Spectral Lines of Mercury," J. C. McLennan, University of Toronto.

"Infra-red Gratings," C. F. Brackett and A. Trowbridge.

"The Question of Valency in Gaseous Ionization," R. A. Millikan and Harvey Fletcher.

"A Probable Explanation of the Irregularities obtained by Ehrenhaft and Przibram in their Work on the Value of the Elementary Electrical

Charge," Harvey Fletcher, University of Chicago.

"Note on a Form of Spectrophotometer," Edward L. Nichols and Ernest Merritt, Cornell University.

A. D. COLE,
Secretary, Section B

SECTION G—BOTANY

AT the convocation week meetings in Minneapolis, Section G held two sessions, one on Wednesday afternoon, December 28, and the other on Friday morning, December 30, under the vice-presidency of Professor R. A. Harper. Dr. William Crocker served as secretary in the absence of the regular secretary, Dr. Henry C. Cowles. The customary address of the retiring vice-president was necessarily omitted, owing to the death of Professor Penhallow. The program consisted of four special addresses and a number of technical papers, abstracts of which appear below.

The section unanimously adopted the following resolution regarding the death of Vice-president Penhallow: The botanists of the American Association for the Advancement of Science note with sorrow the absence from our meetings of David Pearce Penhallow, long a member of the association and a year ago the vice-president for the Section of Botany. We shall miss his tall impressive figure, his kindly voice and his keen and discriminating discussion. We here inscribe upon the minutes of the Section of Botany this tribute to his worth, and request the council of the association to make an appropriate entry upon its record.

Upon motion of Professor Newcombe, it was unanimously voted to request the council to appoint a committee to investigate the conditions for research in the Bureau of Plant Industry.

The following officers were chosen:

Vice-president—Professor F. C. Newcombe.

Member of the Council—Professor F. C. Newcombe.

Member of the Sectional Committee (five years)—Professor L. H. Pammel.

Member of the Sectional Committee (one year, to fill the vacancy caused by the death of Professor Barnes)—Professor L. R. Jones.

Member of the General Committee—Professor C. E. Allen.

SPECIAL ADDRESSES

Imperfect Fungi as Causes of Wheat-sick Lands and of Deterioration in the Quality and Yield of Wheat: H. L. BOLLEY (abstract below).

The Organization of the Fruit-bodies of Hymenomycetes: A. H. REGINALD BULLER.

A Summary of Ecological Results from Colorado: FREDERIC E. CLEMENTS.

A South Sea Botanical Trip: JOSEPHINE E. TILDEN.

ABSTRACTS

The Work of Imperfect Fungi in Cereal Crop Deterioration: HENRY L. BOLLEY.

This paper gives an outline of experiments conducted at the North Dakota Agricultural College, dealing with the relation of the imperfect fungi in cereal cropping.

The essential conclusions may be summarized about as follows: the soils of the older wheat areas of the northwest are in the same sort of sanitary condition as the old flax-cropped lands and may quite properly be spoken of as wheat-sick or wheat-tired in the same sense as has previously been shown for flax lands. Wheat and other cereal lands are not necessarily depleted chemically as indicated by many agricultural and chemical writers, but may be only incapable of producing proper yields because of poor sanitary conditions in the soil or in the seed.

Soil and seed-born diseases have been and are the agents which vitiate the conclusions of many well-planned schemes of agriculture, as, for example, in fertilizer trials and crop rotations. These diseases, in large measure, account for the types of soil deterioration which agriculturists have had largely under discussion; much of the supposed improvement which has been described by such writers as applicable to special systems of cropping and of soil fertilizing have, in large measure, been due to bettered sanitary conditions rather than especially improved conditions as to soil fertility.

The genera of fungi which have been worked out as destructive to flax, wheat, oats and barley are found to belong to the old group of *Fungi imperfecti*. Of these the chief ones are *Helminthosporium*, *Colletotrichum*, *Fusarium*, *Macrosporium* and *Alternaria*.

There may be several species of each of these different genera at work. By cross infection, it is found that some of the kinds which attack wheat also attack barley. It is particularly interesting to note that practically all of the kinds which attack wheat also attack quack-grass. This accounts in large measure for the destructive influences which quack-grass has upon the development of the young cereal crop over quack-grass areas.

Chief among the lines of work which have en-